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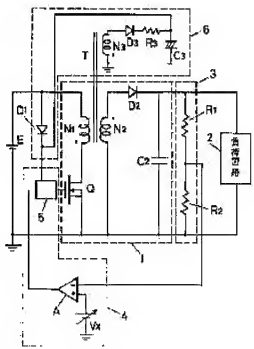
(54) POWER SUPPLY UNIT

(57)Abstract:

PURPOSE: To provide a compact, low-priced power supply unit for a control circuit or a drive circuit by creating a power supply capable of delivering an almost constant voltage from a winding of a transformer without using another power supply even though the output voltage of flyback type voltage. means fluctuates.

CONSTITUTION: In a power supply unit using a flyback type voltage step-up and -down step-up and -down means by connecting a primary winding N1 of a transformer T through a switching element Q to a DC power supply E and incorporating a diode D2 and a capacitor C2 connected to a secondary winding N2 of said transformer, a separate winding N3 is provided in the transformer T, a capacitor C3 is connected to said separate winding N3 through a diode D3, and the diode D3 is connected in a direction which makes the line conductive between the separate winding N3 and capacitor C3 when the switching element Q turns on.



DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates DC power supply to pressure up or the electric power unit which lowers the pressure and supplies direct current voltage or a volts alternating current to a load circuit.

[0002]

[Description of the Prior Art]Drawing 4 is a circuit diagram of a conventional example, changes the direct current voltage of DC power supply E into required voltage, and shows the typical thing of the electric power unit supplied to the load circuit 2. Hereafter, the circuitry is explained with operation. The transistor Q performs switching operation under control of the control circuit 4. When the transistor Q is one, current flows into primary winding N_1 of the transformer T, and energy is stored in the transformer T. Next, if the transistor Q is come by off, the energy accumulated in the transformer T will be supplied to capacitor C_2 via diode D_2 from secondary winding N_2 of the transformer T. By repeating this operation and performing it, energy is supplied to capacitor C_2 from DC power supply E, and the voltage of capacitor C_2 rises. The voltage generated in capacitor C_2 is detected as a partial pressure value of resistance R_1 and R_2 by the voltage detector 3, and is inputted into the negative input of the error amplifier A. The reference supply Vk is connected to the plus input of the error amplifier A, and the result of having compared the value of the negative input and the plus input with the error amplifier A is told to PWM controller 5. In response to this signal, PWM controller 5 drives the transistor Q so that the pressure value from the voltage detector 3 and the pressure value of the reference supply Vk may become equal. Thereby, predetermined voltage occurs in capacitor C_2 and the load circuit 2 is supplied. The power supply 6 for control circuits is established in order to supply a power supply to the control circuit 4. When the energy stored in the transformer T which secondary winding N_2 and 3rd winding N_3 are like-pole nature, and was mentioned above is supplied to capacitor C_2 by OFF of the transistor Q, Similarly energy is supplied to capacitor C_3 via diode D_3.

The voltage generated in capacitor C_3 is determined by the turn ratio of secondary winding N_2 and 3rd winding N_3 at this time, the voltage which generates the number of turns of secondary winding N_2 in capacitor C_3 when making the number of turns of n_2 and 3rd winding N_3 into n_3 becomes twice [n_3/n_2] the voltage of capacitor C_2. At the time of circuit starting, a power supply is supplied to the control circuit 4 via diode D_1 from DC power supply E, and a circuit begins operation. Then, since a power supply is supplied to the control circuit 4 from capacitor C_3 even if the voltage of DC power supply E falls by the valley of pulsating flow, etc., a circuit becomes possible [continuing operating].

[0003]Thus, in the conventional electric power unit, in order to acquire the power supply of control circuit 4 grade, winding is separately formed in the transformer T. The voltage obtained at this time is decided by output voltage of an electric power unit as mentioned above. Since it is controlled by the conventional electric power unit to become constant [output voltage], the voltage obtained will also become fixed.

[0004]

[Problem(s) to be Solved by the Invention]However, in a case when there is the necessity of the output voltage of an electric power unit not being constant, and changing it in the big range, so that loads may be electric discharge lamps, such as a HID lamp, for example, When the power supply of a control circuit etc. was created from the transformer by the method adopted with the conventional electric power unit, the voltage was also changed in proportion to output voltage, and there was a problem that desired voltage was not obtained. In such a case, another power supply may be established and the power supply for a direct control circuit or drive circuits may be created from DC power supply. However, when another power supply was established, there was a problem of a device being enlarged.

[0005]The place which this invention is made in view of the above points, and is made into the purpose, It is in providing a small and cheap electric power unit by creating the power supply for the control circuit where almost fixed voltage is obtained, a drive circuit, etc., without establishing another power supply, when changing output voltage.

[0006]

[Means for Solving the Problem]If it is in an electric power unit of this invention, in order to solve the above-mentioned technical problem, as shown in drawing 1, The transformer T by which primary winding N_1 was connected to DC power supply E via switching element Q. In an electric power unit of composition of that had a flyback type step-down-and-step-up means containing diode D_2 and capacitor C_2 which were connected to secondary winding N_2 of this transformer T, and the load circuit 2 was connected to an outgoing end of a step-down-and-step-up means, Said transformer T is equipped with another winding N_3 in addition to primary winding N_1 and secondary winding N_2, Capacitor C_3 is connected to this another winding N_3 via diode D_3, Diode D_3 is connected in the direction which makes it flow through between said another winding N_3 and capacitor C_3, when said

switching element Q is turned on.

[0007]

[Function]Since diode D_3 was connected in the direction which makes it flow through between another winding N_3 of the transformer T, and capacitor C_3 when switching element Q was turned on if it was in this invention, When changing output voltage, almost fixed voltage is obtained by capacitor C_3. Therefore, the power supply for a control circuit, a drive circuit, etc. can be created, without establishing another power supply.

[0008]

[Example]The 1st example of this invention is shown in drawing 1. Among a figure, it is resistance, Vx is a variable reference supply, and R_3 of others is the same as that of a conventional example.

Hereafter, operation of this circuit is explained. When output voltage is variable and this electric power unit changes the pressure value of the reference supply Vx, output voltage changes. Except for the power supply 6 for control circuits, composition is the same as a conventional example, and operation is also as above-mentioned. The point different from a conventional example is the composition of the power supply 6 for control circuits.

It is the point which 3rd winding N_3 of the transformer T makes secondary winding N_2 and heteropolarity by this invention to 3rd winding N_3 of the transformer T having become the same polarity as secondary winding N_2 in the conventional example.

In the conventional example, when the transistor Q turned off, the energy stored in the transformer T was supplied to capacitor C_3 via diode D_3 from 3rd winding N_3 of the transformer T. Since secondary winding N_2 of the transformer T and 3rd winding N_3 is [heteropolarity, i.e., primary winding N_1 and 3rd winding N_3,] like-pole nature in this invention, When one [the transistor Q], energy is supplied to capacitor C_3 via diode D_3 and resistance R_3 of ****** from 3rd winding N_3 of the transformer T. If the number of turns of n_1 and 3rd winding N_3 is made into n_3, the voltage generated in capacitor C_3 the number of turns of primary winding N_1, It becomes almost equal to what multiplied primary winding n_1, turn ratio n_3/n_1 of 3rd winding n_3, and the pressure value of DC power supply E. That is, even if it changes output voltage, when the voltage of capacitor C_3 is determined uniquely, without being influenced and it changes output voltage, the always stable power supply is acquired.

[0009]Drawing 2 is a circuit diagram of the 2nd example of this invention. A diode, C_4, and C_5 among a figure D_4 and D_5 A capacitor, Q_1 - Q_4 -- a transistor and 2 -- a load circuit and 21 -- as for a full bridge inverter circuit and 8, a control circuit, and 11 and 13 are [a choke coil and 6] drive circuits a current detecting circuit and 9 the power supply for drive circuits, and 7 a discharge lamp and 22. Hereafter, operation of a circuit is explained briefly. This circuit changes the direct current voltage of DC power supply E into the volts alternating current of an abbreviated square wave, and supplies it to

the load circuit 2.
This example shows the case where the discharge lamp 21 is connected as the load circuit 2. The transistor Q switches, for example at several 10 kHz like the above-mentioned example. Transistor Q_1 of the full bridge inverter circuit 7 - Q_4 perform switching operation, for example at several 100 Hz, and perform inverter operation. Thereby, the voltage of an abbreviated square wave is supplied to the load circuit 2. Based on the information given from the voltage detector 3 and the current detecting circuit 8, the control circuit 9 carries out switching operation of the transistor Q so that predetermined electric power may be supplied to the load circuit 2, and it drives the full bridge inverter circuit 7. In order to drive transistor Q_1 and Q_3 by the side of the high potential of the full bridge inverter circuit 7, since ground potential differs, the drive circuits 11 and 13 for exclusive use are required. This example is an example which used this invention, in order to make the power supply of the drive circuits 11 and 13. Capacitor C_4 and C_5 which were connected to the drive circuits 11 and 13 are a power supply of each drive circuits 11 and 13, and are charged via diode D_1 and diode D_4, and D_5, respectively from DC power supply E at the time of circuit starting. When power supply voltage falls by the valley of pulsating flow, etc. after circuit starting, it charges to the voltage generated in capacitor C_3, and as for capacitor C_4 and C_5, a power supply required for the drive circuits 11 and 13 is stabilized, and they are given.
[0010]Drawing 3 is a circuit diagram of the 3rd example of this invention. Nine among a figure a control circuit and 10 a current detecting circuit, and 11-14 A drive circuit, As for N_3, the 4th winding and N_5 the 3rd winding and N_4 The 5th winding, D_3 - D_5 are the power supplies for drive circuits, and resistance, C_3 - C_5 of a diode, R_3 - R_5 are [a capacitor and 6] the same as that of the example above-mentioned [other composition]. This example changes DC power supply E into the volts alternating current of an abbreviated square wave, and supplies it to the load circuit 2. The transistor Q performs switching operation by several kilohertz like a front example. In the full bridge inverter circuit 7, for example The state of the OFF [transistor Q_1 and Q_4] of one, transistor Q_2, and Q_3 by several 100 Hz, Switching operation is performed so that the state of one [transistor Q_1 and Q_4] of OFF, transistor Q_2, and Q_3 may change. Thereby, since the connection polarity over the transformer T of capacitor C_2 will change, exchange of an abbreviated square wave is supplied to the load circuit 2. The control circuit 9 switches the transistor Q so that predetermined electric power may be supplied to the load circuit 2 with the detecting signal of the current detecting circuit 10.
[0011]This circuit is a thing of the type with which the input and the output were insulated. Therefore, the power supply from which three potential differs for the drive circuits 11-14 which drive the full bridge inverter circuit 7 is required.
In this example, 3rd winding N_3, 4th winding N_4, and 5th winding N_5 are provided in the transformer T, and this is made possible. The power supply of the drive circuits 12 and 14 is capacitor C_3, and the

power supply of the drive circuit 11 is [the power supply of capacitor C_4 and the drive circuit 13] capacitor C_5. Energy is supplied to each capacitor C_3, C_4, and C_5 via winding N_3, N_4, diode D_3 from N_5, D_4, D_5, and resistance R_3, R_4 and R_5, respectively. Since energy is supplied to capacitor C_3 - C_5 from DC power supply E and these are charged in this example when the one [the transistor Q] at the time of circuit starting, Next, by the time the transistor Q turns off, the drive circuits 11-14 can give a driving signal to transistor Q_1 - Q_4, respectively. Therefore, even if the transistor Q turns off, capacitor C_2 is supplied via diode D_2 from secondary winding N_2, surge voltage occurs, and a circuit does not damage the energy stored in the transformer T.

[0012]As mentioned above, in the 1st - the 3rd example, when output voltage changes a lot by using this invention, as for a HID lamp, impedance falls rapidly after start up (for example, when making electric discharge lamps, such as a HID lamp, into load).

Then, it changes to the value at the time of rated lighting gradually with stand going up of light. Ramp voltage is also the same, for example, it changes from about 10V to about [which is rated voltage] (85V grade) number 10V. Also in this case, the power supply of stable voltage can be easily made by forming winding in the transformer T separately. Since energy is supplied to capacitor C_3 which serves as a power supply then from DC power supply E for every switching operation of the transistor Q, the thing of small capacity may be sufficient as capacitor C_3, and it becomes small.

While becoming unnecessary to make a power supply directly from DC power supply E according to another power supply for a control circuit or a drive circuit and miniaturizing a device by the above thing, a cheap electric power unit can be provided also in respect of cost.

[0013]Although FET was written as a switching element in the example, the switching means of a bipolar transistor, IGBT, and others may be sufficient. Other loads may be sufficient although the load circuit mentioned the electric discharge lamp as the example. Although output voltage described direct current voltage and abbreviated rectangular wave voltage, other waveforms, such as a sine wave, may be sufficient as it. The control system of not only a PWM control system etc. but others may be sufficient as the control circuit 9. What rectified exchange may be sufficient as DC power supply E.

[0014]

[Effect of the Invention]In the electric power unit which carries out step-down and step-up of the DC power supply, and supplies direct current voltage or a volts alternating current to a load circuit in this invention, Output voltage is not constant, and a power supply can be easily created from a main transformer, without establishing another power supply as a power supply for a control circuit or drive circuits, for example, when loads are electric discharge lamps, such as a HID lamp, when changing sharply.

Therefore, it is effective in the ability to provide a small and cheap electric power unit.

[Translation done.]